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USDA Forest Service
Research Note INT-215

February 1977

DELAYED GRAFT INCOMPATIBILITY IN WESTERN WHITE PINE

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ABSTRACT

A form of graft incompatibility was observed 11 years after a seed orchard of grafted western white pine was established. After 16 years, over 60 percent mortality had occurred in 4 of the 13 clones studied and two more were beginning to show symptoms of graft incompatibility.

KEYWORDS: *Pinus monticola*, graft, incompatiblity, seed orchard

A seed orchard of grafted western white pine (*Pinus monticola* Dougl.) was established in 1959 at Sandpoint, Idaho (Bingham and others 1963). Differences in degree of graft incompatiblity were apparent soon after planting (Hanover 1962). In 1970, 11 years after grafting, additional mortality due to delayed incompatiblity was detected in one clone and, a few years later, in four other clones. This paper describes the symptoms of incompatibility and the extent of damage that occurred in the seed orchard.

MATERIALS

Thirteen trees were chosen as ortets. The selection was based upon the above-average performance of their progeny in resistance to blister rust (caused by *Cronartium ribicola*). Scions were collected in November 1958, packed in snow, wrapped in plastic, and frozen until used.

Stock plants originated from the general white pine population and presumably were susceptible to blister rust. The seedlings were 4 to 5 years old and were established in pots one season prior to grafting.

Grafting was started in January 1959 and was completed in about 3 weeks. The grafts were held in a greenhouse and shade house until planted at Sandpoint, Idaho, in April 1960. Ramet mortality and health were recorded annually.

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OBSERVATIONS AND DISCUSSION

A clear distinction could be made between highly compatible and highly incompatible clones (table 1). Clones 25, 58, 65, and 150 were highly incompatible and eight others were highly compatible. Clone 17 was intermediate between the two groups.

The first signs of delayed incompatibility were expressed a few years after grafting, when differential growth of stock and scion was noted. Two types of abnormal growth occurred. In one case, the scion grew slower than the stock and formed an undergrowth (fig. 1A). In the other type, the scion grew faster than the stock and formed an overgrowth (fig. 1B). Most ramets of three incompatible clones (58, 65, and 150) formed the undergrowth, whereas most ramets of one incompatible clone (25) formed the overgrowth. Besides the trees showing overgrowth and undergrowth at the graft unions, many incompatible grafts showed no noticeable differences in stem diameter at the union. The next visible symptom of incompatibility was a yellowing of the foliage. Foliage yellowed on all trees with incompatible grafts in anywhere from a few months to 2 years prior to death of the tree. When the bark surrounding the graft union was peeled away

Table 1.--*Levels of incompatibility in clones of western white pine grafted in 1959 and observed through 1975*

Clone	Ramets/clone	Dead trees	Yellow trees[1] Nov. 1975	Incompatibility
				Percent
17	96	3	0	3.1
19	53	0	0	0
22	93	0	0	0
24	71	0	0	0
25	63	44	0	69.8
37	36	0	0	0
54	2	0	0	0
58	126	72	24	76.2
63	11	0	0	0
65	83	59	4	75.9
69	29	0	0	0
103	17	0	0	0
150	9	6	1	77.8

[1]Yellow foliage is the first sign of the impending death of the tree. Death usually follows in a few months but sometimes takes place as much as 2 years later.

Figure 1.--Differential growth of stock and scion of incompatible grafts of western white pine: A, *Undergrowth;* B, *overgrowth.*

from a tree with yellow foliage, dead or dying bark tissues and pockets of pitch could be seen. Most of the necrotic tissue was in the stock (fig. 2). In every case checked, the stock died first and the scion shortly after.

Graft age determined which type of incompatibility symptoms would appear. An early type showed up soon after grafting (Hanover 1962); so clones were ranked according to scion survival 20 months after grafting. A second type, delayed incompatibility, became visible 11 years after grafting. There was significant clonal variation in the appearance of this symptom. Effects of the reaction were observed in clone 25 in 1970 and in clones 17, 58, 65, and 150 in 1973, 14 years after grafting. The presence or absence of yellow foliage in 1975 reflects this order. Mortality in clone 25 seems to have run its course. Many ramets of clone 19, which appeared to be a compatible clone, now show the undergrowth symptom that is often correlated with graft failure. No other incompatibility symptoms are visible, but the status of clone 19 is questionable.

Delayed incompatibility occurred at about the time trees changed from seedling to adult phenotypes. Delayed incompatibility may be triggered by the aging of root stock. Also, the first big cone crop was produced in 1969, 10 years after grafting, and every year since has been a good cone crop year in the orchard. The added stress of a cone crop could have triggered delayed incompatibility.

These results indicate that seed orchards of grafted western white pine are subject to considerable loss because of graft rejection. One possible way to partially circumvent the problem would be to graft fewer ramets per clone and include many more clones in the orchard. Another possibility would be to develop highly graft-compatible root stocks, as is now being done for Douglas-fir (Copes 1973).

Figure 2.--Graft unions with bark removed: A, compatible graft with slight undergrowth, graft union not visible; B, incompatible graft clearly showing graft union. Outer bark layers have been removed revealing dead cortex, phloem, and cambium tissues.

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☆U.S. GOVERNMENT PRINTING OFFICE: 1977-0-777-023-18